CLAIMS

What is claimed is:

1. A decoder that is operable to perform symbol decoding of an LDPC (Low Density Parity Check) coded modulation signal, the decoder comprising:

a check node update functional block that calculates a plurality of forward metrics and a plurality of backward metrics that correspond to symbol of a plurality of symbols of the LDPC coded modulation signal;

wherein the check node update functional block uses the plurality of forward metrics and the plurality of backward metrics that correspond to each symbol of the plurality of symbols of the LDPC coded modulation signal to update a plurality of edge messages that corresponds to a plurality of edges that communicatively couple a plurality of symbol nodes to a plurality of check nodes within an LDPC coded modulation bipartite graph that corresponds to an LDPC code;

a symbol sequence estimate and symbol node update functional block that computes a plurality of possible soft symbol estimates for each symbol of the plurality of symbols of the LDPC coded modulation signal;

wherein the symbol sequence estimate and symbol node update functional block updates the plurality of edges using the plurality of possible soft symbol estimates;

wherein the check node update functional block and the symbol sequence estimate and symbol node update functional block cooperatively perform iterative decoding of the plurality of symbols of the LDPC coded modulation signal; and

wherein, during a last iterative decoding iteration, the symbol sequence estimate and symbol node update functional block makes a best estimate for each symbol of the plurality of symbols of the LDPC coded modulation signal using that symbol's corresponding plurality of possible soft symbol estimates.

2. The decoder of claim 1, wherein:

the LDPC coded modulation signal is a variable modulation signal;

a first symbol of the plurality of symbols is mapped according to a first modulation that includes a first constellation and a corresponding first mapping; and

a second symbol of the plurality of symbols is mapped according to a second modulation that includes a second constellation and a corresponding second mapping.

3. The decoder of claim 2, wherein:

the first modulation includes an 8 PSK (8 Phase Shift Key) shaped constellation whose constellation points are mapped according to the first mapping; and

the second modulation includes the 8 PSK shaped constellation whose constellation points are mapped according to the second mapping.

4. The decoder of claim 1, wherein:

the LDPC coded modulation signal is a variable code rate signal;

a first symbol of the plurality of symbols is encoded according to a first code rate; and

a second symbol of the plurality of symbols is encoded according to a second code rate.

5. The decoder of claim 1, wherein:

the check node update functional block calculates the plurality of forward metrics and the plurality of backward metrics that correspond to each symbol of the plurality of symbols by employing min* processing.

6. The decoder of claim 1, wherein:

the symbol sequence estimate and symbol node update functional block updates the plurality of edges using the estimates of each symbol of the plurality of symbols by employing min* processing.

7. The decoder of claim 1, wherein:

the decoder is implemented within a communication device; and

the communication device is implemented within at least one of a satellite communication system, an HDTV (High Definition Television) communication system, a cellular communication system, a microwave communication system, a

point-to-point communication system, a uni-directional communication system, a bi-directional communication system, a one to many communication system, a fiber-optic communication system, a WLAN (Wireless Local Area Network) communication system, and a DSL (Digital Subscriber Line) communication system.

8. A decoder that is operable to perform symbol decoding of an LDPC (Low Density Parity Check) coded modulation signal.

9. The decoder of claim 8, wherein:

the LDPC coded modulation signal is a variable modulation signal;

a first symbol of the plurality of symbols is mapped according to a first modulation that includes a first constellation and a corresponding first mapping; and

a second symbol of the plurality of symbols is mapped according to a second modulation that includes a second constellation and a corresponding second mapping.

10. The decoder of claim 9, wherein:

the first modulation includes an 8 PSK (8 Phase Shift Key) shaped constellation whose constellation points are mapped according to the first mapping; and

the second modulation includes the 8 PSK shaped constellation whose constellation points are mapped according to the second mapping.

11. The decoder of claim 8, wherein:

the LDPC coded modulation signal is a variable code rate signal;

a first symbol of the plurality of symbols is encoded according to a first code rate; and

a second symbol of the plurality of symbols is encoded according to a second code rate.

12. The decoder of claim 8, further comprising:

a check node update functional block that calculates a plurality of forward metrics and a plurality of backward metrics that correspond to symbol of a plurality of symbols of the LDPC coded modulation signal;

wherein the check node update functional block uses the plurality of forward metrics and the plurality of backward metrics that correspond to each symbol of the plurality of symbols of the LDPC coded modulation signal to update a plurality of edge messages that corresponds to a plurality of edges that communicatively couple a plurality of symbol nodes to a plurality of check nodes within an LDPC coded modulation bipartite graph that corresponds to an LDPC code;

a symbol sequence estimate and symbol node update functional block that computes a plurality of possible soft symbol estimates for each symbol of the plurality of symbols of the LDPC coded modulation signal;

wherein the symbol sequence estimate and symbol node update functional block updates the plurality of edges using the plurality of possible soft symbol estimates;

wherein the check node update functional block and the symbol sequence estimate and symbol node update functional block cooperatively perform iterative decoding of the plurality of symbols of the LDPC coded modulation signal; and

wherein, during a last iterative decoding iteration, the symbol sequence estimate and symbol node update functional block makes a best estimate for each symbol of the plurality of symbols of the LDPC coded modulation signal using that symbol's corresponding plurality of possible soft symbol estimates.

13. The decoder of claim 12, wherein:

the check node update functional block calculates the plurality of forward metrics and the plurality of backward metrics that correspond to each symbol of the plurality of symbols by employing min* processing.

14. The decoder of claim 12, wherein:

the symbol sequence estimate and symbol node update functional block updates the plurality of edges using the estimates of each symbol of the plurality of symbols by employing min* processing.

15. The decoder of claim 8, wherein:

the decoder is implemented within a communication device; and

the communication device is implemented within at least one of a satellite communication system, an HDTV (High Definition Television) communication system, a cellular communication system, a microwave communication system, a point-to-point communication system, a uni-directional communication system, a bi-directional communication system, a one to many communication system, a fiber-optic communication system, a WLAN (Wireless Local Area Network) communication system, and a DSL (Digital Subscriber Line) communication system.

16. A decoding method that performs symbol decoding of an LDPC (Low Density Parity Check) coded modulation signal, the method comprising:

receiving a symbol block, that includes a plurality of symbols, of the LDPC coded modulation signal;

mapping the plurality of symbols according to at least one modulation that corresponds to the plurality of symbols thereby generating a plurality of mapped symbols, wherein the at least one modulation includes a constellation and mapping;

making initial estimates of each mapped symbol of the plurality of mapped symbols;

calculating initial conditions of a plurality of forward metrics and a plurality of backward metrics that correspond to at least one symbol of the plurality of mapped symbols;

beginning with the initial conditions of the plurality of forward metrics and the plurality of backward metrics that correspond to the at least one symbol of the plurality of mapped symbols, calculating a plurality of forward metrics and a plurality of backward metrics that correspond to each mapped symbol of the plurality of mapped symbols;

updating a plurality of edge messages, that corresponds to a plurality of edges that communicatively couple a plurality of symbol nodes to a plurality of check nodes within an LDPC coded modulation bipartite graph that corresponds to an LDPC code, using the plurality of forward metrics and the plurality of backward metrics that correspond to each mapped symbol of the plurality of mapped symbols;

computing a plurality of soft symbol estimates for each mapped symbol of the plurality of mapped symbols;

updating each edge message of the plurality of edges messages using the corresponding plurality of soft symbol estimates for each mapped symbol of the plurality of mapped symbols;

performing iterative decoding of the plurality of mapped symbols; and

during a last iterative decoding iteration, estimating each mapped symbol of the plurality of mapped symbols using that mapped symbol's corresponding plurality of soft symbol estimates thereby generating best estimates of each symbol of the plurality of symbols of the LDPC coded modulation signal.

17. The method of claim 16, wherein:

the LDPC coded modulation signal is a variable modulation signal;

further comprising:

mapping a first symbol of the plurality of symbols according to a first modulation that includes a first constellation and a corresponding first mapping; and

mapping a second symbol of the plurality of symbols according to a second modulation that includes a second constellation and a corresponding second mapping.

18. The method of claim 17, wherein:

the first modulation includes an 8 PSK (8 Phase Shift Key) shaped constellation whose constellation points are mapped according to the first mapping; and

the second modulation includes the 8 PSK shaped constellation whose constellation points are mapped according to the second mapping.

19. The method of claim 16, wherein:

the LDPC coded modulation signal is a variable code rate signal;

a first symbol of the plurality of symbols is encoded according to a first code rate; and

a second symbol of the plurality of symbols is encoded according to a second code rate.

20. The method of claim 16, wherein:

the calculating of the plurality of forward metrics and the plurality of backward metrics that correspond to each mapped symbol of the plurality of mapped symbols is performed by employing min* processing.

21. The method of claim 16, wherein:

the updating the plurality of edges using the estimates of each mapped symbol of the plurality of mapped symbols is performed by employing min* processing.

22. The method of claim 16, wherein:

the method is performed within a decoder;

the decoder is implemented within a communication device; and

the communication device is implemented within at least one of a satellite communication system, an HDTV (High Definition Television) communication system, a cellular communication system, a microwave communication system, a point-to-point communication system, a uni-directional communication system, a bi-directional communication system, a one to many communication system, a fiber-optic communication system, a WLAN (Wireless Local Area Network) communication system, and a DSL (Digital Subscriber Line) communication system.

23. A decoding method that performs symbol decoding of an LDPC (Low Density Parity Check) coded modulation signal, the method comprising:

calculating a plurality of forward metrics and a plurality of backward metrics that correspond to each mapped symbol of a plurality of mapped symbols that is mapped from a plurality of symbols of the LDPC coded modulation signal;

updating a plurality of edge messages, that corresponds to a plurality of edges that communicatively couple a plurality of symbol nodes to a plurality of check nodes within an LDPC bipartite graph that corresponds to an LDPC code, using the plurality of forward metrics and the plurality of backward metrics that correspond to each mapped symbol of the plurality of mapped symbols;

computing a plurality of soft symbol estimates for each mapped symbol of the plurality of mapped symbols;

updating each edge message of the plurality of edges messages using the corresponding plurality of soft symbol estimates for each mapped symbol of the plurality of mapped symbols;

performing iterative decoding of the plurality of mapped symbols; and

during a last iterative decoding iteration, estimating each mapped symbol of the plurality of mapped symbols using that mapped symbol's corresponding plurality of soft symbol estimates thereby generating best estimates of each symbol of the plurality of symbols of the LDPC coded modulation signal.

24. The method of claim 23, further comprising:

receiving a symbol block, that includes a plurality of symbols, of the LDPC coded modulation signal;

mapping the plurality of symbols according to at least one modulation that corresponds to the plurality of symbols thereby generating the plurality of mapped symbols, wherein the at least one modulation includes a constellation and mapping;

making initial estimates of each mapped symbol of the plurality of mapped symbols;

calculating initial conditions of a plurality of forward metrics and a plurality of backward metrics that correspond to at least one symbol of the plurality of mapped symbols; and

beginning with the initial conditions of the plurality of forward metrics and the plurality of backward metrics that correspond to the at least one symbol of the plurality of mapped symbols, calculating the plurality of forward metrics and the plurality of backward metrics that correspond to each mapped symbol of the plurality of mapped

symbols that is mapped from the plurality of symbols of the LDPC coded modulation signal.

25. The method of claim 24, wherein:

the LDPC coded modulation signal is a variable modulation signal;

further comprising:

mapping a first symbol of the plurality of symbols according to a first modulation that includes a first constellation and a corresponding first mapping; and

mapping a second symbol of the plurality of symbols according to a second modulation that includes a second constellation and a corresponding second mapping.

26. The method of claim 25, wherein:

the first modulation includes an 8 PSK (8 Phase Shift Key) shaped constellation whose constellation points are mapped according to the first mapping; and

the second modulation includes the 8 PSK shaped constellation whose constellation points are mapped according to the second mapping.

27. The method of claim 23, wherein:

the LDPC coded modulation signal is a variable code rate signal;

a first symbol of the plurality of symbols is encoded according to a first code rate; and

a second symbol of the plurality of symbols is encoded according to a second code rate.

28. The method of claim 23, wherein:

the calculating of the plurality of forward metrics and the plurality of backward metrics that correspond to each symbol of the plurality of mapped symbols is performed by employing min* processing.

29. The method of claim 23, wherein:

the updating the plurality of edges using the estimates of each mapped symbol of the plurality of mapped symbols is performed by employing min* processing.

30. The method of claim 23, wherein:

the method is performed within a decoder;

the decoder is implemented within a communication device; and

the communication device is implemented within at least one of a satellite communication system, an HDTV (High Definition Television) communication system, a cellular communication system, a microwave communication system, a point-to-point communication system, a uni-directional communication system, a bi-directional communication system, a one to many communication system, a fiber-optic communication system, a WLAN (Wireless Local Area Network) communication system, and a DSL (Digital Subscriber Line) communication system.